UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

MEMORANDUM

SUBJECT: Letter to the Administrator from Great Rivers Environmental Law Center Regarding the West Lake Landfill Site Remedy

FROM: Cecilia Tapia
Director, Superfund Division

TO: William W. Rice
Acting Regional Administrator

At your request, we have reviewed and responded to the concerns raised in the subject letter dated April 2, 2009. The Great Rivers Environmental Law Center objects to EPA's Selected Remedy for the West Lake Landfill Site Operable Unit 1 (Site) described in the Record of Decision (ROD) which was signed by the Regional Administrator in May 2008. This commenter also provided extensive comment at the Proposed Plan stage. EPA provided detailed responses to all comments in the Responsiveness Summary issued with the ROD. EPA conducted an extensive public process for the Site. EPA held three public meetings and held the comment period open for more than six months.

For your awareness, the Missouri Department of Natural Resources (MDNR) has been heavily involved in the oversight of this project from the beginning. MDNR concurred with the Selected Remedy. Beginning at the Proposed Plan stage in 2006, the Site documents have been subject to supplementary reviews by ATSDR and additional EPA staff including a second senior RPM, a member of the AWMD radiation staff, and a senior hydrogeologist. The Region consulted with Headquarters' radiation site policy staff at the Proposed Plan stage and the draft ROD was subject to extensive panel review at the Headquarters level.

More recently, at your request, EPA Headquarters performed a further revision of the remedy for the Site. They assigned the review to technical staff proficient in landfill remedies, radioactive waste remediation, and hydrogeology. As a result of this review, EPA Headquarters made the following recommendations:

1. Installation of air monitoring stations on-site and off-site.
2. Groundwater monitoring for contaminants at the waste management unit boundary and at off-site locations.

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3. The cap should meet UMTRCA guidance for a 1,000-year design plan including an additional thickness to prevent radiation emissions.
4. Flood protection measures should consider 500-year storm event under the assumption that the levee is breached.

The subject letter does not raise any new information or concerns that EPA has not thoroughly considered in the remedy selection process. Our position on these issues is reiterated below. For ease of reference, the comments from the letter are repeated here and then followed by the response. The comments are italicized to clearly distinguish them from EPA's responses. For purposes of this memorandum, Great Rivers will be referred to as "the commenter".

Supporting Memorandum

In May 2008 the U.S. Environmental Protection Agency issued a Record of Decision (ROD) ratifying a plan to deal with radioactive waste in the West Lake Landfill (Bridgeton Sanitary Landfill). The waste had been illegally dumped there in 1973. Over the years erosion caused some of the radionuclides to migrate onto private property adjacent to the landfill, known as the Buffer Zone/Crossroad Property. (See ROD, pp 1-3.)

The Mallinckrodt Chemical Works (MCW) in St. Louis processed uranium ore from 1942-1957 under contracts with the Manhattan Project and the Atomic Energy Commission. Beginning in 1946, Mallinckrodt dumped the residues of this processing at a tract now known as the St. Louis Airport Site (SLAPS). (ROD 1-2.) The residues that found there way to West Lake Landfill consist of uranium, thorium, and other radioactive elements that occur when those two elements decay. (ROD 23-24.)

The EPA's Selected Remedy is to put rocks, construction rubble and clay on top of the radioactive wastes. Contaminated soil from the Buffer Zone/Crossroad Property would be excavated and consolidated with the radioactive Operable Unit One at the landfill. "Institutional Controls" (land use restrictions) are intended to prevent human contact with the radioactive waste during the many thousands of years that it will continue to decay. Long-term monitoring, particularly of groundwater, is contemplated. (See EPA's ROD, pp. xi-xii, 42-47.)

Response: This account is largely accurate although the commenter attempts to minimize EPA's Selected Remedy by describing it as putting rocks, construction rubble, and clay on top of the wastes. In fact, the remedy is to construct an engineered multilayer landfill cover, establish and maintain land use controls, and implement long-term monitoring and maintenance plans. This approach serves to prevent human contact with the wastes and isolate the wastes from the environment. This approach is consistent with the state-of-the-industry for landfill closure and landfill site remediation. This approach is used in cases involving a full range of wastes and contaminated materials including long-lived radionuclide contamination. Moreover, the long-term monitoring is more than contemplated, it is explicitly required.

In cases where the remedy results in hazardous substances remaining on-site, CERCLA requires ongoing forms of surveillance, monitoring, maintenance, institutional control, etc. The expectation is that this will continue for as long as the hazardous substances remain. In this case as with many Superfund sites, the monitoring period will extend beyond the foreseeable future. The challenge is no greater in this case than at various other sites where long-lived radionuclides, heavy metals, or other persistent waste materials will be permanently disposed or managed in place. If the West Lake wastes were moved to another landfill, the ongoing stewardship requirements at that location would remain the same.

A primary objective is to make sure the engineering measures are designed for longevity. Most of the engineering measures used at the Site will continue to be effective even in the event that institutional control becomes ineffective at some point in the future. The landfill cover identified in the Selected Remedy relies on natural materials that should remain effective for a vast period of time. The thickness and properties of the materials used will be more than sufficient to shield any future users of the site from any increased gamma exposure, and the materials will act to mitigate radon gas emissions. The cover will also incorporate a layer of rock or concrete rubble. This feature will inhibit the potential for intrusion into the landfill and limit the potential for erosion into the waste material. The shallow sloping requirements for this cover will also help to minimize the potential for erosion and enhance longevity. Thus, the landfill cover will prevent potential exposures and will remain effective for as long as the cover materials are left in place.

Additionally, the objective is to make the long-term site management plans as robust as possible. Long-term operation & maintenance (O&M) plans will establish requirements for long-term groundwater monitoring, institutional control implementation, assurance, periodic inspection, maintenance, and community involvement. These plans will be approved by EPA in consultation with MDNR and made available to the public.

Clearly, the protectiveness of the Selected Remedy does not rely on institutional controls alone. However, the engineering controls will be supplemented with an institutional control strategy designed to limit land and resource use and protect the integrity of the engineering controls. The Selected Remedy will use redundant mechanisms including enforceable proprietary controls that run with the land. Specifically, the remedy includes environmental covenants pursuant to the Missouri Environmental Covenants Act which is specifically designed to support use restrictions at contaminated sites. Also, the Site has been listed by MDNR on the State's Registry of Confirmed, Abandoned, or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Uncontrolled Sites Registry). The registry is maintained by MDNR pursuant to the Missouri Hazardous Waste Management Law. Sites listed on the registry appear on a publicly available list. A notice is filed with the County Recorder of Deeds and notice must be provided by the seller to any potential buyers of the property.

Finally, CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) require that periodic reviews, referred to as five-year reviews, be conducted. At least every five years, a review will be performed to evaluate the remedy to assure it remains protective of human health and the environment and is performing as expected. In the event the remedy is not protective or is not performing as expected, these findings will be presented in the Five-Year Review Report and corrective measures will be required to be undertaken. The Five-Year Review Report will also describe maintenance issues, recommended optimizations, identify new requirements, etc. This process also provides for community involvement.

The purpose of the letter is to shine light on two major inadequacies in the EPA's analysis: (1) the failure to acknowledge the high levels and dangers of the radioactivity in the landfill, and (2) the failure to acknowledge the impact of those wastes on the ground and surface water and on the air.

Response: EPA has fully acknowledged the presence of radioactive contaminants in the landfill and fully acknowledged the existing and potential impacts of all environmental media. EPA has gone to great lengths to measure the levels of contamination at the Site, evaluate pathways for migration, estimate exposures and risks, and thoroughly report the findings.

EPA has applied the Superfund Remedial Investigation/Feasibility Study (RI/FS) process in accordance with all program expectations. EPA has made publicly available the results of all site investigations. The nature and extent of contamination has been fully investigated and reported on. All data have been made available. The risk assessment was produced in accordance with standardized conservative methodologies using accepted toxicity data.

The radiologically contaminated material in the landfill is soil mixed with residues that were the byproduct of uranium ore processing. As part of the RI, extensive field study was performed on the landfill and the waste materials including overland gamma surveys, surface and subsurface sampling through an extensive boring program, downhole radiological logging, radon flux measurements, perched water and landfill gas sampling, surface water and sediment investigation, etc. The data provide the primary basis for the technical judgments that have been made in the EPA decision-making process.

The radiologically contaminated soil in the landfill does not present a health threat to the general public under current conditions because there is no opportunity for exposure. That Site is fenced and access controlled. No drinking water sources are impacted. As long as the Site is used in ways consistent with it being a landfill, there is no public health concern.

Significant exposure to the radionuclides at the Site could occur under potential future circumstances if no remedial action is taken. The baseline risk assessment looked at some of these potential scenarios based on reasonably anticipated land use including groundskeepers and other workers using the Site for storage or other ancillary purpose.

The assessment uses standard exposure factors and toxicity values to estimate the lifetime health risks to these hypothetical workers. Under two of the worker scenarios examined, the calculated risks exceed EPA's acceptable risk range defined as 1 X 10^{-4} or 1 in 10,000.

The general conclusion is that members of the general public, i.e., people who live and work in the vicinity of the Site, are not at risk under current conditions. There are potential risks to future on-site workers or others who might come in direct contact with the contaminated material. The potential risks are not acute and can be managed by preventing direct contact with the waste materials.

Furthermore, the EPA failed to propose an alternative remedy.

Response: It is unclear what the commenter is driving at here given there is no requirement or expectation under the Superfund process to propose an alternative remedy. The general requirement under NCP is to evaluate a range of alternatives to identify the preferred alternative that provides the best balance of trade-offs when compared against the nine evaluation criteria. The expectations for what sorts of alternatives need to be developed and evaluated are provided in 40 CFR Section 300.430(e). The number and type of the alternatives to be analyzed is determined by taking into account the scope, characteristics, and complexity of the site problem that is being addressed. To narrow the field, a preliminary screening of alternatives is done based on effectiveness, implementability, and cost. A detailed analysis is performed on a limited number of viable alternatives that are protective and comply with applicable or relevant and appropriate requirements (ARARs). The analysis also includes a "no action" alternative to provide a baseline for comparison. The detailed analysis consists of an assessment of the individual alternatives against each of the nine evaluation criteria and a comparative analysis that focuses on the relative performance of each alternative against those criteria. The CERCLA evaluation criteria are explained in Section 10 of the ROD and can be found at 40 CFR Section 300.430(e). The Site FS evaluation complied with all the requirements. Six remedial alternatives were subject to detailed analysis: Alternative L1 – No Action; Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring; Alternative L3 – Soil Cover to Address Gamma Exposure and Erosion Potential; Alternative L4 – Regrading of Areas 1 and 2 (minimum slope of two percent) and Installation of a Subtitle D Cover System; Alternative L5 – Regrading of Areas 1 and 2 (minimum slope of five percent) and Installation of a Subtitle D Cover System; and Alternative L6 – Excavation of Material with Higher Levels of Radioactivity from Radiological Area 2 and Regrading and Installation of a Subtitle D Cover System.

In EPA's extensive experience with landfill sites, it has become clear that all viable alternatives will generally involve on-site containment as a principal component of the remedy because of concerns regarding whether complete excavation can be achieved and because the costs of such excavation grossly exceed the benefit derived from excavation. Excavation of waste materials from any landfill introduces a variety of risks and complications. For example, there are risks associated with spills during transport and

the increased risk of traffic accidents. Excavation involves many worker safety issues, both from potential exposure to toxics and from the physical hazards of having to manually excavate, sort, and sample various types of refuse, debris, and oversized objects. Excavation introduces the potential for spreading contamination due to complicated water management issues, decontamination issues, and dust suppression concerns. Uncovering putrescible waste introduces the potential for odor emissions and bird problems.

Generally, the objective of the decision process in these cases is to identify the best option for existing land disposal units considering the evaluation criteria. EPA has a lot of experience with CERCLA municipal landfill sites. Approximately 20 percent of the sites on the Superfund National Priorities List (NPL) are municipal landfill sites. These sites share many similar characteristics including large waste volumes and heterogeneous mixtures of municipal waste frequently co-disposed with industrial and hazardous wastes. In many cases, the hazardous chemical substances are much more toxic and more mobile in the environment than the radionuclides contained at the Site. Nevertheless, containment in place has been the primary remedy selected in these cases (EPA 1994; EPA 1991).

At landfill sites, EPA will often evaluate the potential for hot spot removal. In the context of CERCLA municipal landfill sites, the term "hot spot" is a term-of-art. It is used to refer to discrete volumes of highly toxic or highly mobile wastes located within the much greater volume of heterogeneous material that makes up the landfill waste. Typical examples include buried drums containing hazardous chemicals or lagoons full of liquid industrial waste. Under the guidelines, such hot spots should be evaluated for removal. In some cases, a large portion of the more toxic waste material is contained in a relatively small accessible volume, potentially making removal of the hot spots a prudent option (EPA 1993).

The radiologically contaminated soils at the Site are mixed within the larger volume of waste material and do not qualify as hot spots. However, EPA did develop and evaluate an alternative involving removal of a portion of the radiologically contaminated material – Alternative 6 – *Excavation of higher levels of radioactivity from Area 2 and regrading and installation of a Subtitle D cover system.* By assuming a subset of waste material with relatively higher concentrations, the objective was to define an excavation alternative that had a chance to compare favorably with containment only under the evaluation process. The evaluation favors capping alone versus the partial excavation and capping alternative for a number of reasons. The partial excavation alternative has much greater potential for human exposures and increased physical hazards during the implementation phase. Also, the excavation alternative introduces many large uncertainties associated with cost and implementability. In the end, the same closure and post-closure care is required. By virtue of removing some of the contamination prior to capping, Alternative L6 does offer some greater theoretical measure of long-term protection over capping alone in the event the remedy is compromised at some point in the future; however, this advantage is small compared to the disadvantages.

FUSRAP

As it happens, there is already a federal program for dealing with the same radioactive waste from the earliest decades of the Atomic Age – the Formerly Utilized Sites Remedial Action Program (FUSRAP, commonly pronounced "fuse rap") presently administered by the U.S. Army Corps of Engineers. Under FUSRAP the Corps is already remediating or has remediated the other St. Louis City and County sites contaminated by MCW wastes: the St. Louis Airport Site and its Vicinity Properties such as Coldwater Creek; the St. Louis Downtown Site; the Hazelwood Interim Storage Site (HISS) and nearby Latty Avenue Vicinity Properties; and the Madison Site in Illinois.

At all these sites contaminated soil and other materials have been excavated and transported to "an out-of-state licensed or properly permitted facility," according to the Corps' St. Louis Districts FUSRAP web page. One facility is specified by the Corps: Envirocare of Utah's (now EnergySolutions) licensed low-level radioactive waste disposal facility.

Response: EPA is quite familiar with FUSRAP. The St. Louis Airport site and the Latty Avenue sites were listed on EPA's NPL in 1989. The U.S. Department of Energy and EPA Region 7 entered a Federal Facility Agreement (FFA) for cleanup of the St. Louis FUSRAP sites in 1990. The U.S. Army Corps of Engineers (USACE) has acted as a successor agency under FFA since cleanup authority was transferred to the USACE in 1998. EPA was a party to the development of the RI/FS and ROD documents for both the St. Louis Downtown site and the North St. Louis County sites. EPA's oversight role in the cleanup of the St. Louis FUSRAP sites remains in effect.

The commenter continues to imply that action under FUSRAP would automatically call for excavation of the radioactive wastes and removal to an off-site location. This is not the case. The Atomic Energy Commission (AEC) established FUSRAP in March 1974 under the authority of the Atomic Energy Act of 1954 to identify, investigate, and take appropriate cleanup action at sites where work was performed in support of MED and early AEC programs. FUSRAP provides federal funding to designated sites. FUSRAP does not establish a decision framework for remediation; it is CERCLA that provides the response authority and governs the decision-making process in both cases. If the Site was an eligible and designated FUSRAP site, the cleanup responsibility would be transferred from the private responsible parties to the USACE but the response framework would continue to be CERCLA. Both the North St. Louis County FUSRAP sites and the Site are NPL sites. Any differences in the remedies selected for the Site versus the St. Louis FUSRAP sites are a function of differing site-specific circumstances; the differences cannot be attributed to the fact that one site is FUSRAP and the other is not.

In the case of the North St. Louis County sites, the contaminated media is generally surface soils. The contaminated soil is or was widely distributed across approximately 80 properties including SLAPS, owned by the city of St. Louis, and a variety of properties used for a variety of purposes, e.g., commercial, light industrial, recreational, open fields,

and transportation facilities. The mostly private properties are criss-crossed with public roadways, railroads, and utility right-of-ways. The majority of these soils are accessible to the public. The contaminated soil is located in places where workers or members of the public might reasonably be expected to come into contact with it. Moreover, many of these properties are being used or could be used in ways that are incompatible with leaving the soil in place. These considerations were factored into the remedy which calls for the accessible contaminated soils to be excavated and shipped for commercial disposal (USACE 2003; 2005).

A subset of the St. Louis FUSRAP contaminated soils, referred to as the inaccessible soils, are located under roads, active rail lines, buildings, and other permanent structures. There are over 69,000 cubic yards of contaminated soils in this category. The inaccessible soils do not pose an exposure concern as long as the road or other permanent structure remains in place. The Selected Remedy for the inaccessible soils at the North St. Louis County North FUSRAP sites is to manage these in place using institutional controls (USACE 2003; 2005).

In contrast to the situation in North St. Louis County, the Site has been a landfill site since the early 1950s and will remain a dedicated landfill site into the future. The radiological contamination is disposed with other wastes in the landfill. The current use and the reasonably anticipated future use of the Site is as a landfill. Access to the Site is access controlled. In short, waste disposal is consistent with current and future land use at the Site; such is not the case for the St. Louis sites. If there is an analogy to be drawn with the St. Louis FUSRAP, it is with the inaccessible soils that, like the soils in the landfill, do not pose a health concern as long as the barrier to exposure remains in place.

EPA's Proposed Remedy

EPA's remedy for West Lake is to treat it as a municipal waste landfill under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, better known as the Superfund Law). (ROD 49-50.) In addition to the usual cover for landfills, EPA has borrowed some standards from the Uranium Mill Tailings Radiation Control Act (UMTRCA) and proposed "a hybridized cover system incorporating a rock or concrete rubble layer to restrict biointrusion and erosion into the underlying landfilled materials." (ROD 50-51.)

Response: More accurately, the Site is a CERCLA municipal landfill site. The landfill contains some radiologically contaminated material that is not typical of municipal solid waste but this factor has been fully considered and accounted for. Consistent with the CERCLA process, EPA's Selected Remedy incorporates all ARARs found in other environmental laws. These include the closure and post-closure requirements found in the Missouri Solid Waste Rules as well as the Protection Standards for Uranium and Thorium Mill Tailings. The radiological contaminants at the Site are similar in nature to those found at mill tailing sites (EPA 2008).

This hybrid remedy is inadequate. No liner or physical structure is proposed that would prevent radionuclides from migrating into the groundwater.

Response: Groundwater samples were obtained from a network of on-site monitoring wells over a period of years and analyzed for a wide range of chemicals including radionuclides, trace metals, petroleum hydrocarbons, volatile organic compounds, semivolatile organic compounds, pesticides, and polychlorinated biphenyls. Surface water and perched water samples have also been analyzed for these compounds. The results generally show sporadic and isolated detections of a small number of contaminants at relatively low concentration levels (EMSI 2000; 2006). The groundwater results show no evidence of significant leaching and migration of radionuclides from Areas 1 and 2. The vast majority of the results are consistent with background concentrations. This is the case even though the waste materials have been in place without a landfill cover for over 30 years. In other words, significant leaching and migration of radionuclides to perched water or groundwater have not occurred despite landfilled waste materials having been exposed to worst-case leaching conditions from surface water infiltration over a period of decades.

Capping through the use of engineered covers is a well understood and routinely applied technology that forms a barrier between the contaminated material and the surface (EPA 2007). Capping is the approach used at uranium mill tailing sites for example. The cover system is designed to shed water and incorporate a low permeability layer. This restricts surface water infiltration into the waste material and minimizes the potential for contaminants to be leached to the groundwater. It is important to understand that it is the cover, not a liner, which prevents surface water from contacting the waste material.

Installation of a proper landfill cover system will serve to ensure that the groundwater remains protected. Moreover, the long-term groundwater monitoring program will be designed to verify over time that the remedy is protective of the groundwater. The objectives of the monitoring program are described in Section 12 of the OU 1 ROD. The monitoring plan required as part of the remedy will specify sampling locations, sampling frequencies, analytical parameters, procedures, etc. Periodic sampling reports that include data summaries and interpretation will be published. After the baseline is established, trend analysis will be used to verify performance.

EPA's objections to the removal of the radioactive waste boil down to three arguments:

1. *The waste is not that "hot."*
2. *There is no migration pathway by which radionuclides could enter groundwater.*
3. *The waste is too dispersed in the large volumes of nonradioactive waste in the landfill.*

Response: EPA does not object to removing waste material. EPA's goal is to select and implement a remedy that protects human health and the environment in accordance with the Superfund law and implementing regulations. The objective of the decision process is to identify the best option for existing land disposal units considering the evaluation

criteria. CERCLA evaluation criteria are explained in Section 10 of the ROD and can be found at 40 CFR Section 300.430(e).

The three points listed by the commenter do a poor job of summarizing EPA's position. EPA's decision is risk-based and the potential health threats posed by Site contaminants are dependent not only on contaminant concentration but also on the potential for human exposure. Also, we disagree with point number 2. As long as waste materials in the landfill are exposed to infiltrating surface water, the potential for migration to groundwater remains. To address this, the Selected Remedy calls for construction of a multilayer engineered cover that meets sloping and permeability requirements designed to shed water and minimize the potential for water to infiltrate the waste material. This is the same kind of technology used successfully at permitted landfills. With the low leaching potential of the waste materials and an engineered cover in place, the probability of continued groundwater protection is very high.

The information compiled during the RI/FS indicates that the waste can be safely managed in place using well understood landfill techniques, while excavation of waste materials from this or any landfill introduces a variety of risks and complications. For example, there are risks associated with spills during transport and the increased risk of traffic accidents. Excavation involves many worker safety issues, both from potential exposure to toxics and from the physical hazards of having to manually excavate, sort, and sample various types of refuse, debris, and oversized objects. Excavation introduces the potential for spreading contamination due to complicated water management issues, decontamination issues, and dust suppression concerns. Uncovering putrescible waste introduces the potential for odor emissions and bird problems. The potential to attract birds raises specific safety and administrative issues for the Site due to its proximity to the Lambert-St. Louis International Airport.

Moreover, there is no clear path to commercial disposal for the wastes in Areas 1 and 2. There are very few currently available commercial disposal facilities for radiologically contaminated materials and most of those are automatically excluded as an option through compact restrictions. In addition, none are permitted to accept municipal solid wastes. The Energy Solutions facility in Clive, Utah, could be an option but it has specific preacceptance criteria imposed by license. Acceptable waste forms are categorized as soil and debris waste streams due to the placement criteria specified in the license (EnergySoultions WAC). The soil waste stream must meet specified properties for compaction, particle size, density, etc. Waste not meeting the specified soil properties is considered standard sized debris or oversized debris based on dimensions. Therefore, the nature of necessary waste handling or treatment prior to disposal as well as the final unit disposal cost is highly uncertain. Sanitary and putrescible wastes would likely not be acceptable. Screening of the refuse to separate out the soil material from the trash might be required. This would be a difficult, labor-intensive, time-consuming, costly, and potentially hazardous activity. Screening of the refuse material would require people to remove plastic, wood, and other material that would otherwise clog or foul the screens. In addition to the physical hazards (e.g., slip, trip, fall, danger from moving machinery),

such workers could be exposed to elevated levels of gamma radiation from which effective protection is difficult.

It is estimated that there are approximately 146,000 cubic yards of radiologically contaminated material at the Site. To illustrate the potential transportation risks associated with an off-site disposal alternative, we assume there is an available commercial disposal option. This illustration also ignores waste bulking factors and therefore underestimates volumes. If 146,000 cubic yards were removed for off-site disposal, at 20 cubic yards per truckload, this would result in approximately 7,300 trips by heavy trucks on public roads. Assuming a distance to the railhead of 5 miles, the total round trip distance by the hauling fleet on public roads would be about 65,000 miles. Reported by data from the Motor Carrier Management Information System, Missouri has the seventh highest annual rate of fatal truck involvements and St. Louis County is the highest in the state. At 100 cubic yards per gondola car, it would require 1,460 railcar loads or about 15 100-car trainloads with a total rail distance for remote off-site disposal of about 48,000 miles. Applying data collected by the National Highway Traffic Safety Administration and the Federal Railroad Administration indicate that the average risk of accident involving injury or death for this alternative exceeds 1.0.

In short, excavation options are much more difficult and time consuming to implement, much more expensive, involve much greater uncertainty, and actually introduce unnecessary health and safety risks.

Radioactivity

Radioactive material was found in two parts of the landfill at levels well above background and reference levels: in Area 1 to a depth of 7 feet and in places down to 15 feet; in Area 2 to a depth of 12 feet and, and in places, more (ROD 10, 82-86).

EPA acknowledges that Areas 1 and 2 "contain substantial quantities of long-lived radionuclides mixed with the municipal solid waste and thus present conditions that are not typical of landfill sites." (ROD 28) It says that there are no "hot spots" of particularly concentrated radioactive waste (ROD 31) because the waste is "dispersed in a heterogeneous mix." (ROD 42) In reconstructing the history of the Mallinckrodt waste EPA determined that the portion destined for West Lake consisted of 8,700 tons of "leached barium sulfate cake" of which 7 tons was uranium; this barium sulfate cake was "reportedly mixed with 39,000 tons of soil" and used as cover on the landfill. (RS 9-10)

Response: This is generally accurate. EPA went to great effort to characterize the nature and extent of the radiologically contaminated waste material and present it in the RI/FS and ROD documents. The leached barium sulfate cake was one of the byproducts of processing the ore for its uranium content. In addition, a condition placed on the ore by the supplier required that radium, radium daughters, lead, and other valuable metals be extracted, stored, and returned to the supplier. Therefore, the Mallinckrodt process

included steps to extract these materials as a separate residue apart from the bulk of the ore residue. The barium sulfate residues are the solids that remain after all efforts have been made to remove the uranium, radium, and other valuable constituents. There is historic information on the unleached barium sulfate cake indicating it contained about 4×10^{-9} grams of radium per gram of residue (0.0000004 percent) and about 0.1 percent uranium (ORAU 2005). The material was then leached as a final step to further remove these constituents. The material was reportedly blended with soil at approximately 5 to 1 before being used in the landfill operation (AEC 1974). An approximate average uranium weight percentage of the soil mixture calculates at about 0.015 percent. As it happens, the analytical results from the samples collected during the RI are consistent with this information.

EPA acknowledges that there "data quality issues" with the sampling done at the site and the analysis of the samples. (RS 27-30)

Response: The commenter apparently intends to imply that there were large or serious data quality problems. This is not true. There were some isolated analytical errors during the RI that were explained or interpreted as expected and required as part of the Quality Assurance/Quality Control (QA/QC) process.

As is required, the RI report and supporting investigations discuss data quality issues and draw conclusions about the representativeness of the data. All of the data obtained as part of the RI have been presented, evaluated, and considered as part of the interpretive process. No data meeting QA/QC criteria were eliminated or otherwise not considered. Any complex environmental investigation involving extensive data collection from various media, multiple sampling events, rigorous data validation procedures, etc., will result in some number of suspect data. The data validation procedures apply standard criteria for data quality that address precision, accuracy, representativeness, comparability, and completeness of analytical data sets. In the event certain analytical results do not conform to expectation, e.g., results are higher or lower than other results obtained from the same location over time, and no error is directly attributable to factors associated with the precision and accuracy of the laboratory analyses, it is incumbent on the data user to consider the representativeness and the comparability of the results relative to the body of evidence. Moreover, one of the requirements of appropriate QA/QC is that the analytical labs are independent and have no interest in the outcome of these investigations. This provides yet another control on outcomes. The RI and supporting documents contain some assessments of certain data that are considered unrepresentative; however, all of the data are presented and considered as part of the RI process.

Colloidal Transport

When radionuclides such as the ones left at West Lake are released into water, they can disperse as liquids, particles, or dissolved gases, or can move by colloidal transport. The acceleration of movement of normally immobile contaminants due to linking up with mobile colloids is referred to as colloidal-facilitated transport. Many studies on

colloidal transport have been done in the years since EPA conducted its original studies. The EPA's decision is no longer based on the best available scientific data. In particular, studies in 1999 and 2002 (completed one through three years after the latest EPA West Lake related studies were done), show that the presence of organic substances enhances the transport of radionuclides through groundwater. In short, we believe that these highly radioactive wastes, if abandoned in the floodplain, could end up in the drinking water of untold numbers of St. Louisans who depend on the Missouri River for their drinking water, as well as people downstream who draw their drinking water from the Mississippi after the Missouri drains into it.

Response: The commenter claims EPA's decision is no longer based on the best available scientific data because some studies on contaminant transport have been done since the RI/FS. The commenter does not name the particular studies in 1999 and 2002; however, we are aware of several recent studies on colloidal transport of radionuclides including: *Mechanisms of Plutonium Transport in a Shallow Aquifer in Mortandad Canyon, Los Alamos National Laboratory, New Mexico*, R. Marty et al; *Colloidal Transport of Plutonium in the Far-Field of the Mayak Production Association, Russia*, R. Ewing & A. Novikov et al; *The Role of Colloids in Uranium Transport: A Comparison of Nuclear Waste Repositories and Abandoned Uranium Mines*; H. Zanker & K. Ulrich et al; *Colloid-Facilitated Transport of Radionuclides Through the Vadose Zone*, M. Flury et al; *Colloid-Facilitated Solute Transport in Variably-Saturated Porous Media: Numerical Model and Experimental Verification*, J. Simunek et al. It is widely recognized that colloids can influence the migration of reactive contaminants. Depending on the conditions, colloids can have both transport-facilitating and transport-impeding effects on contaminant transport.

This work does not affect the Site's Selected Remedy because it does not rely on complex modeling of contaminant fate and transport. The studies conducted during the RI and the conclusions drawn by the FS, the Proposed Plan, and the ROD rely on actual environmental sampling and analysis at the Site and do not rely on fate and transport models. Thus, although the specific studies are not listed by the commenter, it is unlikely the studies contain new information that would influence the conclusions drawn from the site-specific data. The groundwater sampling and analysis includes both filtered and unfiltered samples. So the monitoring results include contaminants found in both the aqueous phase and the solid phase. Any contaminant migration to groundwater can be detected in groundwater samples regardless of the transport mechanisms. This will be true of the long-term groundwater monitoring program as well. In addition, as we have discussed above, the landfill cover that will be constructed as part of the Selected Remedy is designed to prevent percolation of surface water into the landfill thereby mitigating all potential mechanisms of contaminant migration to groundwater including any potential colloidal transport.

The study and modeling of contaminant transport is complex. It deals with a variety of reactions including sorption (by various types of bonding), decay, degradation, complexation, precipitation, dissolution, and volatilization as well as interactions with migrating colloids. These reactions influence and are influenced by various physical

transport mechanisms, i.e., advection, diffusion, and dispersion. The ability to quantify the complex chemical reaction phenomena that control the dynamics of contaminant transport and also integrate the variability in flow behavior caused by natural heterogeneity and fluctuating conditions remains very limited. Developing and improving the predictive capabilities of these models is always an area of active research Berkowitz 2008). EPA will continue to evaluate the practical application of these models as capabilities develop or improve.

Water Contamination

> *"EPA does not dispute that parts of the landfill are built on the historic or geomorphic flood plain....It is also a fact that the landfill is located behind the Earth City Levee system designed to exceed the 500-year flood protection level. Whether the Site is in a flood plain or not is a function of the definition being applied. There has been no intent on EPA's part to confuse anybody on this issue." (RS 50)*

We are confused. EPA says the landfill is in a floodplain, yet it's not because there's a levee, and while a flood could reach the "northwestern toe of the landfill", the cover would protect it. (RS 5)

Response: The reason for continued confusion on this point is not clear. The Site is located at the margin of the Missouri River alluvial deposits. The northern portion of the landfill is built on the alluvium over what was once a flood plain prior to the development of the Earth City Levee District and prior to construction of the landfill. The Earth City Levee system is designed to exceed the 500-year flood protection level; and the area protected by the levee, which includes the northern portion of the Site, is no longer a flood plain. Four major floods have occurred since the levee was completed in 1972 including the record level flood of August 1993 when the Missouri River crested at 14.6 feet above flood stage and remained above flood level for about 110 days. The flood control system functioned successfully in each case (Earth City Levee District Web site).

Most so-called levee "failures" are actually the result of overtopping, i.e., the flood event exceeds the design criteria for the levee. Such an occurrence is extremely unlikely in the case of the Earth City Levee District. However, EPA looked at the conditions that could occur in the event of levee system failure. While such an unlikely occurrence could be devastating for the Earth City Levee District which contains 450 businesses employing 22,800 people, it would be a relative nonevent for the landfill Site. It is important to understand that the landfill itself has altered the topography such that the surface elevation of the Site is 20 to 30 feet or more above the level of the historic flood plain. After construction of the remedy, the cover surface at the landfill will be a minimum of 25 feet above the flood plain. In the event that the levee is breached and 500-year flood waters were to encroach on the business park, it would be expected to result in a maximum of about two feet of water at the northwestern toe of the landfill.

As part of the Selected Remedy, the landfill toe in this area will be regraded through placement of additional clean fill and capped with an engineered landfill cover resulting

in approximately 100 lateral feet of additional materials between the current landfill toe and the toe at completion of the remedial action. Only cover material and clean fill material could potentially come into contact with flood water. No scouring damage due to high energy water would be anticipated because of the distance between the toe and the river which is about 1.3 miles. Nevertheless, flood protection measures are being evaluated as part of remedial design and appropriate bank protection methods will be used in construction of the toe area. Any encroaching flood water would be expected to recede with no damage to the landfill cover. However, in the event any damage does occur, for any reason, it will be repaired in accordance with the O&M plan.

The Missouri River could carry radioactive waste to drinking water intakes for St. Louis County and City. (RS 31)

Response: There is no basis for this statement and we find nothing at the cited location in the Responsiveness Summary that could be construed to support this statement. There is no reasonably arguable mechanism that would result in Site wastes being in the Missouri River. EPA is aware that the Missouri River is a valuable resource and a source of drinking water to St. Louis and beyond. The Site is not a threat to the Missouri River or public water supplies. The groundwater at the Site is not significantly impacted by the radiologically contaminated material in the landfill, and the Selected Remedy will ensure that this remains the case.

EPA concluded that the instances of radioactivity detected in monitoring wells above Maximum Contaminant Levels were not due to migration from the contaminated areas of the landfill (ROD 19-20), or at least not to "significant leaching and migration of radionuclides." (ROD 21) As to water moving off-site:

> *"If groundwater monitoring data show no evidence of a contaminant plume underlying and immediately downgradient of the source material, then it is reasonable to conclude there is no contaminant plume further downgradient at some off-site location that could be attributable to the source material. For this reason, off-site groundwater investigations were not undertaken as part of the RI [Remedial Investigation]." (ROD 21-2)*

Hence groundwater will only be monitored. "Statistically significant deterioration in groundwater quality with time as a result of contaminant migration from Areas 1 and 2 shall be cause to reevaluate the remedy." (ROD 45)

Response: The point or the objection intended by the commenter is not clear; however, we stand by the conclusions and requirements outlined in the ROD.

Groundwater results collected during the RI/FS show no evidence of significant leaching and migration of radionuclides from Areas 1 and 2. The vast majority of the results are consistent with background concentrations. Four wells exhibited a total radium concentration above the maximum contaminant level (MCL) of 5 picocuries per liter (pCi/l). These exceedances ranged from 5.74 pCi/l to 6.33 pCi/l. These exceedances are

isolated spatially. Two of the four wells with total radium exceedances are located in areas that are not downgradient of either radiological Area 1 or radiological Area 2. Uranium isotopes (U-238 and U-234) were generally detected in wells at 5 pCi/l or less. For comparison, the background level is about 2 pCi/l and the drinking water standard is about 20 pCi/l (converted from the uranium MCL of 30 micrograms per liter). Moreover, perched water from locations in the waste material contained in Areas 1 and 2 was sampled and analyzed and elevated concentrations of radionuclides were not detected. This is the case even though the waste materials have been in place without a landfill cover for over 30 years. In other words, significant leaching and migration of radionuclides to perched water or groundwater have not occurred despite landfilled waste materials having been exposed to worst-case leaching conditions from surface water infiltration over a period of decades.

Therefore, the results of extensive monitoring over a period of years show that the radiological contaminants have not had significant impacts on shallow groundwater underlying Areas 1 and 2. Moreover, without significant impacts to the groundwater underlying and immediately downgradient of the waste material, there can be no significant impact to the alluvial aquifer or the Missouri River.

The monitoring objectives outlined as part of the Selected Remedy do provide that "Statistically significant deterioration in groundwater quality with time as a result of contaminant migration from Areas 1 and 2 shall be cause to reevaluate the remedy." It is not clear whether the commenter objects to this, but we believe this is a reasonable condition to impose.

As for the possibility of people drinking contaminated water, "evaluating consumption of groundwater underlying the source is not consistent with a landfill remedy." (ROD 24)

Response: The quoted passage comes from the section of the ROD summarizing site risks and the discussion on exposure assessment. Superfund risk assessment guidance provides that we do not generally evaluate consumption of groundwater underlying a landfill. It is not generally considered a complete pathway or a pathway for potential exposure because it is not reasonable to expect that people would put a drinking water well at the landfill.

Off-site groundwater is a completely different consideration. Risk assessment would likely be performed on any impacted potentially usable groundwater. However, based on the data, no current or potential water supplies have been affected.

Safe Removal of the Waste is Feasible

EPA admits that the waste could be excavated: "It is true that safe removal of the waste is possible. However, it is not the option that provides the best balance of trade-offs when considered against the evaluation criteria provided in the NCP" [National Contingency Plan]. (RS 31)

The Corps of Engineers is excavating soil at the St. Louis FUSRAP sites while leaving in place some contaminated soil that is inaccessible because it lies beneath roads , rail lines, buildings or other permanent structures. EPA says basically, the West Lake waste is in a landfill so we might as well leave it there. Public access in the future will be prevented by institutional controls – land use restrictions. (RS 13-4) Nevertheless, radioactive waste will be excavated from the Buffer Zone/Crossroad Property -- an area of 196,000 square feet (ROD 10) – and placed in the landfill. (ROD 37, 43-4)

Response: Certainly it is true that waste material can be excavated. EPA has never suggested otherwise. As discussed, an alternative involving excavation and remote disposal was developed and evaluated in the FS. For the reasons outlined under ***EPA's Proposed Remedy*** above, this approach does not provide the best balance of trade-offs when considered against the evaluation criteria provided in the NCP. In short, the waste can be safely managed in place using straightforward and conventional methods, whereas, excavation and commercial disposal is a difficult and complex solution that introduces unnecessary risks and uncertainties.

Institutional controls will be used to restrict land and resource use consistent with the Site being used as a landfill. However, the landfill cover will provide a barrier against direct contact with the waste material. When the remedy is in place, access to the surface of the landfill will not pose a human health threat and only land uses that might affect the performance of the cover need to be restricted.

As discussed under ***FUSRAP*** above, any differences in the remedies selected for the Site versus the St. Louis FUSRAP sites are a function of differing site-specific circumstances; the differences cannot be attributed to the fact that one site is FUSRAP and the other is not.

Under the Selected Remedy, up to approximately 3,600 cubic yards of material could be excavated from Buffer Zone/Crossroad Property and consolidated in the area of containment. The extent of contamination on the Buffer Zone/Crossroad Property exceeding unrestricted use cleanup standards is thought to be minor, but a more detailed field investigation will be conducted as part of the remedial design to accurately define the amount of contaminated soil that needs to be removed.

EPA estimates the volume of contaminated material at 24,400 cubic yards in Area 1 and 118,000 cubic yards in Area 2, for a total of 142,000 cubic yards. (ROD 10) Elsewhere the ROD says that over 250,000 cubic yards would have to be excavated (130,000 cubic yards of radiologically contaminated material and 120,000 cubic yards of overburden). (ROD 34) Area 1 covers approximately 10 acres and Area 2, 30 acres, for a total of 40 acres. (ROD 3)

We can compare this to the amount of contaminated material removed from the 21.7-acre St. Louis Airport Site and transported to a federally licensed facility as reported on the St. Louis FUSRAP web page. It totals 214,275 cubic yards – 50% more than the volume of contaminated material in the West Lake Landfill.

Response: It should be noted that these volume estimates are bank cubic yards or in situ volume estimates. To estimate potential shipping and disposal volumes, a substantial bulking factor would need to be applied. For disposed solid waste a reasonable bulking factor is on the order of 200 percent (EMSI 2006).

As discussed under ***FUSRAP*** above, the differing remedies selected for the Site versus the St. Louis Airport site are a function of differing site-specific circumstances. There are many considerations beyond volumes of material that need to be factored in.

The consequences of an inadequate remedy are illustrated by the Shattuck Superfund Site cleanup in Denver, where the EPA decided to remediate radioactively contaminated soil by mixing it with concrete, fly ash and other materials, and creating a monolith. Three years after that project was completed, EPA issued an amended ROD in 2000, choosing the Corps of Engineers to remove the failed monolith and neighboring soil. Using a movable "Mining Structure," the Corps successfully removed over 243,000 tons of contaminated material to a permitted offsite radioactive waste disposal facility.

Response: All the evidence collected during the Site RI/FS indicate that the waste materials in the landfill can be safely managed in place through conventional landfill methods. However, CERCLA and the NCP provide a rigorous and ongoing framework for addressing problems such as the Site. As discussed, the process requires that periodic reviews, referred to as five-year reviews, be conducted. At least every five years, a review will be performed to evaluate the remedy to assure it remains protective and is performing as expected. In the event the remedy is not considered protective or is not performing as expected, these findings will be presented in the Five-Year Review Report and corrective measures will be required to be undertaken. Corrective measures could involve remedy change as necessary.

EPA admits that at West Lake "excavation could be done using conventional dust suppression methods, work place monitoring, and personal protective equipment for workers." (RS 52) However, protecting the public from dust and gas during removal is a real concern. Temporary structures are available that can be placed over the work area and even moved across the landfill as the work progresses. In addition to the Shattuck corrective remediation project, examples of such commercially available structures that have been used on projects with nuclear waste include: the movable shelter designed by American Spaceframe Fabricators International to clean up low-level and transuranic waste at the Cold War weapons facility at Hanford Washington; and Sprung Instant Structures, listing nuclear waste treatment, environmental remediation and remediation enclosures among their industrial applications.

Response: As we have explained, we do think excavation could best be done using conventional dust suppression methods, work place monitoring, and personal protective equipment for workers. We do not believe that the use of temporary or movable structures would be necessary or practical for large-scale excavation of municipal trash and debris from a landfill. The cases cited by the commenter used these technologies to

address circumstances that are not directly relevant to the West Lake case. In the Hanford case, the object was to retrieve deteriorating drums from burial trenches. The arid desert-like conditions including high winds and temperature extremes were hindering productivity. The movable shelter was deployed to protect workers from weather extremes and increase productivity. In the case of Shattuck, the mining structures were used to address potential exposure to the surrounding community during the remediation, but the circumstances necessitating such measures are not present at the Site. In the Shattuck case, the contaminated material was solidified in a concrete and fly ash monolith. The remediation involved demolition of the monolith using hydraulic hammers. In the case of West Lake, we anticipate that the waste material could be excavated, stockpiled, and loaded using conventional dust suppression methods without presenting any exposure potential to the surrounding community. If there was the need for on-site separation of the soil fraction from the municipal trash, then potentially some more sophisticated approach could be necessary. However, this has not been studied because it was not critical to the FS level evaluation.

References

Bagchi, Amalendu. *Design Construction and Monitoring of Landfills, Second Edition*, 1994.

Berkowitz, Brian et al. *Contaminant Geochemistry: Interactions and Transport in the Subsurface Environment*, 2008.

EMSI. *Remedial Investigation Report West Lake Landfill Operable Unit 1*, April 2000.

EMSI. *Feasibility Study West Lake Landfill Operable Unit 1*, May 2006.

EMSI. *Technical Memorandum: Evaluation of Potential "Hot Spot" Occurrences and Removal For Radiologically Impacted Soil West Lake Landfill OU-1*, 2006.

EnergySolutions. *Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria*, Revision 7.

ORAU Team Dose Reconstruction Project for NIOSH. *Basis for Development of an Exposure Matrix for the Mallinckrodt Chemical Company St. Louis Downtown Site and the St Louis Airport Site, St. Louis, Missouri, Period of Operation: 1942–1958*, May 2005.

U.S. Army Corps of Engineers. *Record of Decision for the North St. Louis County Sites*, September 2005.

U.S. Army Corps of Engineers. *Feasibility Study for the St. Louis North County Site*, May 2003.

U.S. Atomic Energy Commission Directorate of Regulatory Operations Region III. *RO Inspection Report No. 040-8035/74-01*, 1974.

U.S. Environmental Protection Agency. *Record of Decision West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1*, May 2008

U.S. Environmental Protection Agency. *Technology Reference Guide for Radioactively Contaminated Media*, 2007. EPA 402-R-07-004

U.S. Environmental Protection Agency. *Technological Approaches to the Cleanup of Radiologically Contaminated Superfund Sites*, 1988. EPA 540-2-88-002.

U.S. Environmental Protection Agency. *Presumptive Remedy for CERCLA Municipal Landfill Sites*, 1993. EPA 540-F-93-035

U.S. Environmental Protection Agency. *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills*, 1996. EPA/540/F-96/020

U.S. Environmental Protection Agency. *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*, 1994. EPA540/R-94/081

U.S. Environmental Protection Agency. *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Site*, 1991. EPA/540/P-91/001